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ABSTRACT

The development of adequate educational programs to provide relevant instruction to train students who will be able to compete for the computer-related jobs of the future requires an understanding not only of the curriculum development process, but also of the capabilities of the computer as an instructional device, the different instructional strategies that may be employed, and considerations in selecting computer hardware and software. To assist in the development of a curriculum plan for incorporating microcomputers into classroom instruction at Fayetteville Technical Institute, a model for curriculum development was adapted to the specific features of the college and a literature review was conducted to develop a checklist of necessary actions and decisions. The curriculum development framework and the resulting checklist focused on the following interactive elements: (1) a possible educational activity is identified; (2) a decision is made to proceed; (3) objectives are identified and refined; (4) a suitable format is designed, considering issues related to hardware, software, personnel needs, instructional methods, scheduling, individualization of instruction, student/instructor roles, and evaluation criteria; (5) the format is fitted into larger institutional patterns; (6) the plan is put into effect; and (7) the results are measured and appraised. (RO)

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THE DEVELOPMENT OF A PLAN TO INTEGRATE MICROCOMPUTERS INTO A CURRICULUM PROGRAM

by

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A PRACTICUM PRESENTED TO NOVA UNIVERSITY
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ABSTRACT

The rapid expansion of microcomputers into all areas of business and industry has created a growing need for personnel with computer experience. The role of education to provide relevant instruction which will train students who will be competitive for the jobs of the future requires that microcomputers be incorporated into the curriculum.

The development of adequate educational programs utilizing microcomputers will require an understanding not only of the curriculum development process, but also the capabilities of the computer as an instructional device, the different instructional strategies which may be employed, and sufficient information concerning computer hardware and software to make a sound decision on their selection.

While the literature is filled with information covering all of these concerns, the curriculum planner is still faced with the task of determining the actions and considerations necessary to plan their course or program. The volume of information available often makes this quite difficult. This study developed a checklist of the actions recommended from a variety of sources to assist in the development of a curriculum program incorporating microcomputers into classroom instruction.

Recommendations included using the checklist to assist in the curriculum development and evaluation process, providing faculty in-service training in computer literacy and on the role of the instructor as a facilitator to the learning activities in the classroom and the addition to the staff of a media specialist who would assist the faculty in the development of local computer software programs. The checklist is found in the appendix.

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INTRODUCTION

A recent survey of 160 of the nation's largest corporations indicated that nearly eighty percent of the present jobs in business and industry involve some type of computer interaction (Kearsley:1981). Large corporations recognize the need for detailed management information and possess the necessary resources to develop efficient computer programs and train their personnel on the program operation. Small businesses have been unable to afford the expense of a large computer and often are unable to provide training to their employees. The availability of low-cost microcomputers has now enabled small businesses to obtain the management information necessary to make sound business decisions. This has contributed to the growing need for personnel with computer experience, particularly in small business concerns.

Lockwood (1983) reported that businesses with fewer than twenty employees create two out of every three new jobs. Firms with fewer than 100 workers employ approximately fifty percent of the work force in the United States. As Lockwood points out, a small business cannot afford to hire persons who lack necessary knowledge and and skills but likewise cannot usually afford the higher salaries commanded by more experienced employees. The effect is that the majority of the newly created jobs are

filled by persons just entering the work force. The end results is that small business must depend upon the education community to supply qualified personnel.

One major function of post-secondary education has traditionally been to provide a gateway to jobs of the future as well as for occupational preparation (Cross:1974). The educational community must continue to provide current and relevant instruction to meet the needs of its students and the community which it serves. The proliferation of the microcomputer at all levels of business has made it clear that computer training must become a part of educational programs if students are to be competitive for current jobs or for those which will be created in the future.

This study considers the actions necessary to integrate microcomputers into a curriculum program at Fayetteville Technical Institute. A review of the literature concerning the various factors involved in the curriculum development process resulted in the compilation of a series of recommended actions. These recommendations formed a checklist which will be used by the FTI curriculum committee as a guide for incorporating microcomputers into the educational programs offered. A copy of the checklist is found in the appendix.

BACKGROUND AND SIGNIFICANCE

Curriculum development is a complex and somewhat imprecise process (Gay:1980). There is no general consensus

concerning an "ideal" development process. Gay outlined four conceptual models of curriculum development; the academic model, the experiential model, the technical model, and the pragmatic model. The academic model considers curriculum development to be a systematic process governed by rationality and logic based on learner characteristics, societal factors and subject matter disciplines. In contrast is the experiential model, which is a learner-centered, activity-oriented approach to learning and teaching. Here is found the personalized, self-paced instructional programs. The third, or technical model, is essentially an analytical approach in terms of "systems management", and "production." It seeks to maximize program proficiency and performance much like industry utilizes with scientific management. Computer-managed instruction is usually considered a product of the technical method of curriculum development. The final model is the pragmatic model. This model supposes that curriculum planners employ a combination of concepts and principles from different theoretical models, along with conventional wisdom, common sense, and with consideration given to the sociopolitical activities of the moment to help develop the curriculum.

While each of these models may be considered acceptable, Gay points out that they are seldom implemented in idealized form, but rather, elements from one or another are combined in curriculum planning. Since the

subject of this study is to develop and describe the curriculum planning process as it involves the use of computers in education, some systematic approach was considered necessary. This study used the framework outlined by Cyril O. Houle in the latest copy of his book, The Design of Education (1972), in which he lists seven decision points and components to be considered in the development of an adulat educational curriculum program:

1. A possible educational activity is identified.
2. A decision is made to proceed.
3. Objectives are identified and refined.
4. A suitable format is designed.
5. The format is fitted into larger patterns of life.
6. The plan is put into effect.
7. The results are measured and appraised.

Houle stressed that the curriculum development process is not accomplished as a sequence of events as may be implied by his outline, but rather as a complex of interacting elements, in which planning may begin with any component and proceed to the others in any order. This model provides an organized approach to describe the process, but is flexible enough to meet the generalized needs of a variety of curriculum programs.

In addition to the complexity of the development process, the integration of microcomputers into an educational program presents the curriculum planner with

several challenges. First, in order to realize the maximum benefit from the use of computer-assisted instruction, the capabilities of computerized instruction must be considered. Bork (1981) outlines a number of ways which a computer can be programmed for learning experiences. The computer can provide individualized instruction furnishing the student with immediate feedback; it can be programmed to provide alternate learning materials; and, it also has the capability to adjust to the speed and comprehension of the learner. Since the computer can store and process a large amount of data, the student can experience situations which would not have been possible using manual systems. The scope and design of the instructional materials are important considerations.

A second challenge to the curriculum planner is how to develop an instructional strategy which will complement the existing classroom needs. Cohen (1982) noted several methods in which the computer can be used in the classroom:

1. As a supplement to the regular curriculum using drill and practice, problem solving and simulation.

2. As a complete curriculum unit where no input from the instructor is needed and the computer functions as the tutor able to teach concepts and provide drill and practice on these concepts.

3. As a pre-programmed authoring device for instructors to create their own programs.

4. As a management system where all records for the curriculum unit are stored and managed by the computer. No instructor is provided in this application of the computer, but rather, its role is to provide accurate records on whether each student has mastered specific objectives and to pinpoint the level at which each student is functioning.

An additional use of computers in an educational setting was demonstrated by Fitzgerald and Francis (1978) who combined the capabilities of the computer as a testing device which when coupled with the management of student records will provide a diagnostic tool. Tests were administered, scored, and immediately reported to the student and the instructor. Remedial study was prescribed in areas where the student was experiencing difficulty. This prompt feedback and directed study resulted in a significantly reduced attrition rate for the course.

The third challenge to incorporating microcomputers into a curriculum course deals with the selection and development of instructional material. One popular myth concerning computers is that there is adequate software which will meet the desired program requirements and needs only to be turned-on and used by the student. Software is readily available for a variety of educational subjects; however, many of these are not of the professional quality needed for post-secondary educational use. The local

design of instructional software is an alternative, but such efforts are a demanding and time-consuming task to be attempted by the instructor and usually will require some specialized knowledge of computer programming. Furthermore, there is no guarantee that the final product will be better than published software.

Another alternative may be to use software developed for business applications. Kearsley (1981) reported that business training program directors stress the need for realistic simulations to train their employees. Commercial applications programs may provide the means to integrate microcomputers into the curriculum which will simulate the practical functions they perform in business and industry.

The development of the curriculum planning document in this study was based on a survey of available literature relating to the use of microcomputers in education. Using the curriculum development process as outlined by C. O. Houle provided the framework for a proposed series of actions considered necessary for the integration of microcomputers into an educational program. In order to provide a useful guide for the curriculum planner and those involved in the approval process, the results of this research were formulated into a checklist which may be used in development and for evaluation. This synthesis of the works of a number of different authors is intended to provide a general direction to an area of curriculum development

which is not yet widely understood. The checklist will be presented to the curriculum committee at Fayetteville Technical Institute for consideration when programs or course revisions are submitted for approval where the incorporation of microcomputers may be requested.

PROCEDURES

The complex nature of the curriculum development coupled with the challenges posed by the use of microcomputers in post-secondary education led to the conclusion that a systematic approach would be required to adequately describe the process. Each of Houle's decision points were considered and researched to determine the actions which may be necessary to incorporate microcomputers into an educational program. This research resulted in a series of recommendations from various authors which were compiled into a checklist of recommended actions to assist with the course and curriculum design.

The identification of a possible educational activity was the initial step in the development process. Educational activities may be identified from many sources; students, educators, community, or society in general. The development of a new or revised curriculum in educational institutions must be grounded in the philosophy and purpose of the school which, in turn, establishes the goals and objectives of the curriculum programs. Since community

colleges have traditionally provided locally based programs designed to meet the needs of the students and the community which they serve, an assessment of the needs of the current student enrollment was used to identify the specefic educational activity for development.

The decision to proceed with the development was the second step in the development process. The stated purpose of the institution together with the needs assessment and other available data provided the justification and rationalization for the decision to proceed with the development. Enrollment trends, current enrollment and attrition statistics, as well as financial constraints were all considerations in this decision.

The identification and refinement of the objectives to be sought in the learning experience was the third major step in the curriculum development. The refinement of the objectives should result in a statement in terms of the accomplishments desired of the learner or in terms of the environment, skills, knowledge, or other performance measures likely to achieve the desired changes in the learner (Gagne and Briggs:1981).

The fourth step in the development process is the development of a suitable format. The design of the format is based in part on foreknowledge of the availability of certain components necessary for the design and the probable needs of the learners which, together with the content of the existing curriculum programs, will be blended into

the format design. Houle outlined ten elements to consider in the format design:

1. Selecting the learning resources. The materials, media, and facilities which will be used to support the educational activitiy must be selected. This will include both the computer and the software programs.

2. Choosing leaders to develop the curriculum and those who will instruct will depend on the skills and knowledges of the personnel available.

3. Selecting the methods for presentation of the educational methodology is the capacity of the leaders to use them. The use of several different methods may stimulate interest on the part of the learner and instructor and should allow the learning experience to be individualized to better meet the needs of the learner.

4. Making a time schedule. Usually the time schedule is established by tradition, necessity, or some arbitrary choice among alternatives.

5. Devising a sequence. The order in which the content is to be learned ranges from the logical structure inherent in the subject such as history to the open-ended content where the learner decides the sequence, as may be found with simulations.

6. Providing social reinforcement of learning. The planner should consider the physical arrangements and activities which may facilitate the socialization

experiences which may assist in accomplishing the educational goals.

7. Adjusting to the nature of each learner. The planner should try to design and conduct the educational activity so that the growth of each participant is fostered.

8. Clarifying roles and relationships. The primary role of teacher and learner in the traditional classroom is different in the computer-integrated educational environment. The role of the instructor in the computer classroom is more that of a resource for the student, to facilitate the learning experience, and not as much the traditional teacher-dominant role.

9. Identifying the criteria for evaluation. The evaluation of the educational activity must have clear standards, rules, or tests to judge the success or failure of the program. Even though these criteria are expected to change over the design process, they should be considered from the start of the development.

10. Explaining the design. The program goals and format should be explained to the students and the instructional staff early in the design process. If instructors are to be expected to fully support the program, they should feel that they had a part in the development process.

The fifth step in the development framework was to fit the program into the life patterns of the persons

who are concerned. Houle points out that adult learners must consider at least four kinds of adjustments in introducing an educational activity into their lives. First, learners must be guided into or out of the activity. This means the planner must consider the course prerequisites, schedules, and support resources such as library or learning laboratory. The need for additional work outside of the classroom for drill and practice or remediation are also considerations. Second, it should be recognized that life styles must be modified to accommodate the educational activity. Houle states that "...education is never simply added to the actions of life; it replaces something else; and that replacement must be carefully considered both when an activity is planned and throughout its duration." Third, financing must be arranged. Houle considered the initial expenditure and other costs to the student as an important consideration. The advent of the low-cost open-door institution may make this of somewhat lesser importance; however, the planner must keep costs in mind. Finally, the purpose and benefit of the activity must be interpreted to the student and community. Adult learners require the support and understanding of their families in order to pursue educational activities.

Implementation of the program was the sixth step in the development process. The original plan should be implemented as it was envisioned and adjusted to meet the

changes required by omissions, errors in decisions, and changed circumstances. The complex nature of curriculum development makes such changes inevitable and makes the constant evolution of the program a desirable outcome.

The measurement and appraisal of results was the seventh and final step in the development process. The extent to which the learners have achieved the terminal objectives must be measured to determine the success or failure of the course. The appraisal interprets these results and estimates the overall success of the program. These two elements form the evaluation. The evaluation completes one cycle of the development process and initiates a revision or identifies a new educational activity for design. It is the constant review and reformulation which makes curriculum development a dynamic process.

LIMITATIONS AND ASSUMPTIONS

This study was limited to the elements of curriculum design which would be considered in the incorporation of microcomputers into the educational programs at Fayetteville Technical Institute. The introduction of microcomputers at other institutions would be dependant on the factors which were considered in identifying an educational activity for development or revision.

This study assumed that the existing curriculum content was adequate except that a change is contemplated

where microcomputers should be incorporated into the course to enhance the value of the program to the students and the community. This permitted the focus on the elements which differed from traditional educational curriculum development.

RESULTS

The survey of the literature resulted in a series of actions considered necessary to the curriculum development process. The actions derived from the research were configured into a checklist for the evaluation of future programs. A copy of the checklist is contained in the appendix. The following information relates the results of the survey to the steps in the curriculum development framework by C. O. Houle and references the work from which the proposed actions were determined.

Identification of an educational activity. The identification of an educational activity for revision or development begins with a consideration of the philosophy and purpose of the educational institution (Gagne and Briggs:1981). The educational philosophy of Fayetteville Technical Institute is stated in the FTI Staff and Faculty Handbook (1983):

> To provide a specialized occupational and general education to fulfill the needs of society and to provide for the fullest possible development of the potential of students so that they may attain effective citizenship.

> To accomplish this purpose, offerings and programs are designed to meet the various interests and aptitudes of all prospective students. Curricular programs are designed to produce highly skilled personnel to meet the needs of the expanding advances in industry, business, health, public service occupations, and general education. These programs also provide the base upon which to build further formal or informal education and strengthen the general educational base of our society.

These statements indicate the responsibility to provide relevant occupational and general education to meet the needs of the community by offering programs designed to provide a pool of trained manpower and to consider the interests and aptitudes of all prospective students.

The interests and aptitudes of prospective students may be obtained from admissions interviews, testing, or from surveys of the current student population. One survey (Shearon:1979) indicated that the population of North Carolina Community Colleges were mostly mature adults who returned to education with specific goals and purposes in mind. The opportunity to earn more money and the ability to obtain a better job were found as the most important factors considered in the decision to participate in an educational activity.

The rapid expansion of the microcomputer into business has made the incorporation of microcomputers into educational programs an urgent priority. Since educating students with the technical and occupational skills needed

to become competitive for the jobs of the future has traditionally been considered the responsibility of the post-secondary educational institutions, it it is incumbent on these institutions to continue to provide relevant programs which will meet these needs. In keeping with the philosophy of preparing students for the jobs of the future, it would appear that microcomputers should be incorporated into curriculum courses wherever possible.

The decision to proceed. The Vice President for Academic Affairs at FTI has committed the institute to continuing the efforts in "...updating all programs to meet the challenge of preparing students to become part of today's highly technical and competitive work force. The future is going to be very interesting as we integrate the computer into all of the educational programs at FTI" (Tech Talk:April, 1983). Even though this statement committed the institution to integrating microcomputers into curriculum programs and insured the necessary priority of resources to the development, the decision to proceed with the integration into a specific curriculum course must still be made by the curriculum committee. Some guidelines are necessary to assist in the evaluation process to insure that all actions necessary for the successful implementation have been considered.

Decisions concerning the course selected for the addition of computers should be based on objective data such as a knowledge of enrollment trends, attrition rates,

the availability of published software, (or the capability to have software developed locally), as well as an overall assessment of the benefit to the students who will participate in the course. The enrollment at FTI has reflected a steady increase over the past decade. The changing numbers of students enrolling in the various curriculum programs offered may be considered an indication of the changes in community needs and interests. Programs which have experienced the greatest increase should be given priority on resources. Courses which are core requirements to curriculum programs also usually have an assured student input to make an investment worthwhile.

The definition and refinement of the objectives of the course. The objectives of the course should be defined in terms of capabilities expected of students after having successfully completed a learning experience (Lehmann: 1971). This requires the curriculum planner to recognize several factors. First, the computer introduces environmental conditions which differ from the cognitive objectives found in a traditional lecture, demonstration, and practice session. Accurate keyboarding of data input will require consideration of the psychomotor skills of manipulation and precision (Bloom:1956 and Harrow:1972). Secondly the minimum acceptable criteria for demonstrating the desired terminal behavior should be stated in terms of behavioral objectives and will include both psychomotor

skills and cognitive objectives. Finally, the determination and specification of the terminal capability desired of the student after successfully completing the learning experience will require some specific measures of success or failure.

Developing a suitable format for the course. Although the objectives defined in the previous step provide the basis for the format development, there are two distinct decisions in format development, those involving selection of the hardware and those concerning software selection. The needs and interests of the students, the capabilities and limitations of the computer hardware, and the adequacy of the available software are considerations in this step (Texas Educational Agency:1982).

The literature is filled with articles, books, and information recommending various computer hardware. The selection of the appropriate hardware for a classroom system may be based on subjective judgement, considerations of compatibility with existing equipment, specialized applications desired, available software, or simply based on cost. FTI decided that compatibility with existing computers would best suit the purpose of the program and minimize costs.

There are at least three sources for computer software; educational programs developed by textbook publishers for classroom use, commercial business applications which may be adapted to classroom use as simulations, or

locally developed programs. The ease with which usable software may be obtained from each of these sources is nearly the same as the order listed, with the locally developed programs most difficult. The instructor is not likely to have the time or expertise in programming necessary for this task. Likewise, extensive problem adaptation of commercial applications software may also be very time-consuming. The reliance on publishers of textbook materials is the most practical; however, several considerations should be addressed (Hamilton:1983):

1. The software selected should be based on the desired method of presentation of the computer portion of the course. A decision to supplement the classroom lecture and textbook sequence is the simplest to implement.

2. The software should make maximum use of the advantages of the computer in its design. The variety of instructional methods which the computer can provide can make the learning experience more interesting for the student.

3. The program should provide prompt feedback to the students on how they are doing.

4. There should be provisions for the student to print the results of assignments for the instructor to check.

5. The program should provide security so that students will not be able to copy another's work.

6. The student should be able to control the pace of the program.

7. The student should be able to exit from the program and start again without repeating the prior portion of the problem.

8. Most programs have some limitations as to the hardware required, input format, and data capacity which should be known.

The leaders are selected. The curriculum design should consider the capabilities of the persons who will develop the course material and also the instructors who will teach the course. The designer may find a checklist such as the one developed in this study of assistance, depending on their background, knowledge, and experience with computers.

The traditional role of instructor as one who dispenses all knowledge in the classroom will not be the same with the computer. The role of the instructor is more to facilitate the progress of the student through the course material using the computer. The instructor will be able to provide more tutorial and individual counselling in the classroom using the increase in time made available from the reduced requirement for lecture preparation and the other functions of classroom management which can be accomplished by the computer (McCombs and Dobrovolny: 1980). Several actions may be accomplished by the planner to assist in this regard:

1. Adequate instructor's manuals, guides, and media support must be made available.

2. Instructors must be familiar with the use of microcomputers and the software to be used in the course.

3. Microcomputers should be made available for the instructors to use to develop proficiency in the programs outside of the classroom area. Such things as classroom management and development of tests should best be done out of view of the students.

4. Instructors should be familiar with common causes of stoppage of the computer in order to handle such problems in the classroom.

The selection of instructional methods. The major consideration in choosing an instructional method is the capability of the learners and instructors (Hall:1981). Some areas for consideration would include:

1. The level of experience of the students both in the subject matter and with computers. It must be assumed that the students will have varied background and educational experiences, making an introduction to the computer essential.

2. The versatility of the computer in providing varied instructional approaches will permit a variety in methods of presentation. The instructional methods should be varied enough to provide a range of experiences to the student and yet maintain the emphasis on the principles to be taught.

3. The methods employed by the computer software program may vary from the traditional classroom sequence and presentation. These differences should be presented and clarified if there is a possibility of student confusion. The use of microcomputers in an accounting course, for example, will require careful explanation of the differences between the computer application to accounting process and the traditional instructional sequence (Stubbe: 1983). The complete accounting cycle consists of the analysis of the financial document, posting the information from the document to a journal, posting ledger accounts, checking the accuracy of the postings by taking a trial balance of the ledgers, preparing the financial statements, closing the ledger accounts, taking a post-closing trial balance, and interpreting the financial reports (Fess and Nieswonger:1981). With the help of the computer, only two of these steps need to be performed by the accounting student, analyzing the source document and entering the data into the journal (Stubbe:1983). The remainder of these functions, except for interpretation of the financial statements, can be accomplished with the press of a few keys. Understanding the accounting cycle from the source document to the final balance sheet report may become a point of confusion unless the student is required to input elements of data at each step in the process. This situation could be handled by either the software design, the classroom

lecture, or the requirement for a comprehensive problem involving the entire accounting cycle.

4. Stubbe also points out another caution when introducing the computer into a classroom situation. The simplification of the repetitive data entry, posting, and the formatting of the output now taught in accounting courses will no longer be required with the computer input. The student may find that using the computer makes a manual process too cumbersome and may stop preparing for the class. Paradoxically, the use of the computer will require a greater emphasis on the need for accurate input of data, and an excellent grasp of fundamental procedures. Input data sheets prepared outside of the classroom may be necessary to minimize this potential problem.

5. Programs for additional drill and practice in subject matter areas where experience indicates the students may need more work should be available. In most cases the instructor may be the most knowledgeable person to develop these programs; however, local development is a time-consuming process and one subject to a number of pitfalls (Lathrop:1983).

Making the schedule. The schedule will depend on the enrollment and other factors such as the time required to work through the software program, the number of programs available, the type and number of computers, and other classroom size constraints (Hamilton:1983).

Devising a sequence of instruction. The sequence of the course will be influenced by the decision concerning the media selection. If the course is to parallel the text presentation, then the decisions as to sequence may have already been made. However, if the decision was made to make the course totally independent from existing offerings, the entire range of decisions concerning course sequence would be required. Considerations in the development of the sequence include the course prerequisites, the presentation of the information, feedback, testing, and enrichment activities.

1. The prerequisites which are prescribed in the school catalog presume minimal pre-instructional preparation of students to allow maximum freedom for students to schedule courses, except where the sequence is essential to the learning process.

2. The presentation of the information must take into account that minimal prerequisites will bring students with varied background to the classroom. Some introduction to computers, demonstration of the proper steps in the use of the equipment and the program, and some supervised student practice is recommended (Klooster:1983). The equipment and software can be damaged by improper handling. As additional information is introduced, the demonstration of simple examples and student simulation followed by student practice and feedback, and testing will be the normal sequence of instruction.

3. The sequence of the course after the introduction to the computer software program could be determined by allowing the student to progress at their own pace or in the more traditional manner with a prescribed sequence which the entire class completes assigned tasks within a specific time.

Providing social reinforcement for the learning experience. The software program may allow for team input during the course. The use of competition such as time to complete a task or the achievement of specific goals may provide greater student interest in the learning experience (Pillsburg and Ripperger:1983).

Adjusting to the nature of each learner. The diagnosis of the progress of each student can be easily obtained by the use of the computer. This individualism is considered one of the major advantages of the computer (Bork:1980). Some considerations include:

1. Diagnostic tests may be provided by the software publisher which can be used to assess the mastery of the subject matter by the student. Such test banks are frequently found as more computers are used in classrooms.

2. Remedial programs should be available if the progress of the student indicates a weakness in specific areas.

3. Drill and practice should be used in areas where experience indicates additional practice would be beneficial. The varied student backgrounds and education

may require the diagnosis and prescription of specific skills needing development. The computer has the capability to perform such diagnosis and prescribe appropriate practice (Fitzgerald and Francis:1978).

Clarify the roles and relationships of the instructor and students. The role of the instructor in computer-assisted learning is more that of a facilitator of student learning in the sense of tutor and not as much the dispenser of knowledge (Hall:1981). The student interacts with the computer program responding to the prompting on the screen. The instructor explains the program and assists the students as they work through the program exercises.

The student role can be defined by requiring the completion of a specified number of exercises throughout the course. This role would be in keeping with the characteristic of adult learners who will accept responsibility for operating a learning experience and participate actively in the experience (Knowles:1970).

Identify the criteria for evaluation. The evaluation should be related to the objectives of the course. The changes in the learner which are implicit in these objectives should be stated in terms which allow measurement and provide an appraisal of the degree to which the student has accomplished them. The behavioral objectives, the expected level of accomplishment, and the method of

evaluation should be provided to the student in a course syllabus (Hunkins:1980).

The design is made clear to all concerned. The instructors should receive training on the computers and equipment to be used and should be encouraged to work through the course material. The student should receive a course syllabus outlining the course objectives and an introduction to the computer operation during the initial class session.

The format is fitted to the larger pattern on life. This consideration may require an adjustment in the curriculum program. Cross (1981) stated that adult learners participate in education for a purpose, usually to gain a specific skill which will get them a better job. They will participate if they feel that the educational activity is worth the effort and is perceived as assisting the student to meet their needs and goals. Houle cited four types of adjustments which should be considered to introduce learning activities to adults:

1. Learners must be guided into and out of an activity. The existance of course prerequisites and student counselling are provided to meet this need.

2. Lifestyles are modified to allow for the time and resources required for the new activity. The imposition of education into the adult lifestyle requires some other activity to be forfeited. Shearon (1979) found that the support of the family toward the participation in an

educational activity is very important to the adult learner. The curriculum design should consider not only the classroom time, but also the homework requirements.

3. Financing is arranged. Even though the cost for attendance at FTI would not normally be considered a difficulty for most students, the additional cost for manuals and diskettes should be considered.

4. Interpret the activity to the public. Since adult learners participate to learn something to be put to immediate use (Cross:1981), the importance of this step to the acceptance of the curriculum program should be recognized.

The program is carried out. Ideally, the course would be tested in a pilot run. If time would not permit a pilot test, the start of the program will require close watch to determine if the content and direction is in accordance with the course objectives. This determination may only be possible after implementation of the course. A periodic review by the faculty may be required to consider if the original purpose and format needs adjustment to adapt to the problems of opportunities in the classroom.

The results are measured and appraised. Some measure of the results of the activity will be required and an estimate of the success of the program should be made. The measures of success may include a comparison

of the current attrition rate with those in prior courses, or a comparison of test scores on similar tests of past courses and the present computer integrated design. The assessment should include the adequacy of the hardware, software, and the documentation provided by the publisher as well as the results of the instruction. Together, the measurements of the success and the assessment form the course evaluation.

Examine the situation in terms of the possibility of a new educational activity. Although the framework by Houle contained only seven steps, the eighth step is implied by the reiterative nature of the model. Since the curriculum development process is cyclical, the evaluation will initiate a new cycle of planning. All phases of the planning process should be considered in light of the experiences of the completed planning cycle. The rapid pace of technological change demands a constant reappraisal of programs and consideration to the expansion of innovative programs to new areas of the curriculum.

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The development of any plan is subject to a number of pitfalls, as the very nature of the planning process introduces an element of uncertainty to the product. The integration of microcomputers into a curriculum course demands a focus on the concepts, capabilities

and problems unique to this instructional media. The literature covers nearly every consideration for the curriculum developer; in fact, the enormous amount of information can be overwhelming. It was with a realization that there is so much information available in so many different forms, that this study was undertaken to provide an overall guide for the integration of microcomputers into the educational programs at FTI.

There are definite advantages to utilizing a structured format in developing a curriculum program, mostly to insure that critical factors receive attention. The development process is a complex and difficult one, and one which is often slighted in the press of other priority affairs. The use of a checklist provides a measure of assurance that the main points of the development process were considered.

The conclusions of this study were:

1. A guide to the integration of microcomputers would be of assistance in the curriculum approval process at FTI.

2. The introduction of microcomputers into existing courses will require as much thought and development effort as any newly designed course. It should be obvious that the complex considerations of this new media cannot merely be added to an educational program.

3. The role of the instructor in the computer classroom will change substantially. This changed role

will need to be explained and instructors may have to change their approach to teaching. This change will likely be difficult to many. Professional development and administration support and encouragement will be necessary as with all new programs and changes.

4. The computer in the classroom will not be all to the advantage of the student nor the instructor. There are a number of things which the computer can do which would be virtually impossible with manual programs such as simulations, but the technology will not be easily harnessed without a great deal of effort on the part of all participants. This may mean additional training for the instructor in computer programming to attain a level of fluency.

5. In the course of research for this study, several versions of textbook publisher software programs were reviewed. In every case, some modification to the package will be required before it can be implemented in the classroom. This points to the fact that the instructor will have to be able to develop materials for their own use or be able to modify published software. Perhaps, as the use of the microcomputer expands in post-secondary education, there will be better programs available. Until such time, the instructor must rely on the publisher.

The recommendations of this study are as follows:

1. The guidelines such as those outlined in the checklist in the appendix of this study should be used

throughout the curriculum development process to insure that all essential considerations are recognized.

2. The curriculum committee should require some objective evidence to accompany a submission to insure that the program has, in fact, considered the necessary elements of the development process before approval.

3. The role of the instructor in the computer classroom should receive further study. The function of a facilitator may not require the same degree of educational background as necessary in the traditional classroom and persons with less training could fill the instructor positions for the computer portion of the course. On the other hand, instructors may require additional training in appropriate classroom practices and techniques to successfully guide the student through the learning experience.

4. The instructors who will use the computer should have a degree of fluency with all aspects of computer operations. The administration should require the development of this fluency for those directly involved and also encourage some level of computer competency for the remainder of the faculty in preparation for future development.

5. The development of adequate programs for use in post-secondary schools will most likely rely on the individual instructor. In order to devote sufficient time to such an effort, special consideration should be

given to allowing time from teaching duties to prepare such materials. An alternative to this would be to provide a computer media specialist to work with the instructor to develop course materials. The specialist would be a person skilled in both media presentation and with proficiency in authoring computer programs. Working in conjunction with an instructor as a subject matter expert, the full benefit of computerized instruction may be realized.

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APPENDIX

CHECKLIST FOR INCORPORATING COMPUTERS INTO CURRICULUM PROGRAMS

PART I - GENERAL CONSIDERATIONS:

A. Identification of the course under development or revision.
   1. Title of course and curriculum program.
   2. Evidence of need related to the statement of philosophy and purpose.
   3. Description of course as it will appear in the school catalog.

B. Justification for development or change.
   1. Rationale for selection of course for development or revision.
   2. Enrollment trends and attrition rates in present course.
   3. Anticipated enrollment in proposed course.
   4. Courses presently offered which are similar or will be replaced by proposed course.

PART II - COURSE OBJECTIVES

A. Capabilities expected of student after having successfully completed proposed course.
B. Current course objectives.
C. Proposed course objectives.
D. Proposed means to measure success or failure after completing course.

PART III - FORMAT CONSIDERATIONS

A. Hardware
   1. Hardware type and quantity requested.
   2. Basis for decision of hardware requested.
      a. Compatability with existing equipment.
      b. Estimated cost of hardware.
      c. Special applications and equipment required.
      d. Printers required and basis for requirement.

B. Software
   1. Source
      a. Educational software. Provide title of software, publisher, and number of copies required.
      b. Commercial applications programs. Describe program, potential use, title, source, and number of copies required.
      c. Locally developed. Outline program objectives, persons necessary for the development, expected time to develop.

2. Instructional strategy.
    a. Supplement to existing course and text.
    b. Replace existing course using new text.
3. Design features.
    a. Drill and practice.
    b. Tutorial.
    c. Problem solving.
    d. Simulation.
    e. Creative applications.
4. Operational features.
    a. Feedback to student.
    b. Capability to print out assignments.
    c. Security of student work.
    d. Student self pace.
    e. Ease of operating program, start up, and exit.
5. Limitations and special considerations.

C. Selection of leaders.
1. Personnel required for course development.
2. Estimate of time needed to train instructors on equipment and software program.
3. Instructional support.
    a. Availability of instructor guides, manuals and media support.
    b. Availability of computer for use of instructor personnel for class and test preparation.

D. Instructional methods to be employed.
1. Introduction to computers for students.
2. Varied instructional presentation.
3. Consider differences between traditional method and sequence and those employed by computer operation.
4. Homework assignments prepared outside of class hours for input into computer.
5. Additional drill and practice available where experience indicated need.

E. Scheduling considerations.
1. Lecture hours required.
2. Computer lab hours required.
3. Classroom lab hours requires.
4. Hours expected for outside preparation by student.

F. Sequence of instruction.
1. Prerequisites to the course.
2. Indoctrination required on use of computer and program.
3. Student self-pace in computer portion of the course.

G. Social reinforcement (if applicable)
1. Team input of data.
2. Competition by individuals or groups.

H. Individualization of instruction.
1. Diagnostic tests by publisher to evaluate progress.
2. Remedial programs available.
I. Clarify roles and relationships of students and instructors.
1. Instructors
a. Explain the role of the instructor.
b. Provide in-service training in techniques as facilitator.
2. Students
a. Course objectives outline.
b. Provide course syllabus.
J. Identifying the criteria for evaluation.
1. Related to the course objectives.
2. Measures the degree of success in mastering course material.
3. Method of evaluation clearly stated in student syllabus.
K. Making the design clear to all concerned.
1. Publish schedule of course offerings.
2. Publish course description for college catalog and local advertising.
3. Explain nature and scope of course to students together with objectives and evaluation.

PART IV - FIT THE FORMAT INTO THE LARGER PATTERN OF LIFE

A. Guide the learner into the program through the use of stated prerequisites.
B. Estimate the total time which the student may be expected to expend in order to successfully complete the course.
C. Consider the financial costs to the students.
D. External publicity about the program and internal information on the course for advising of students by faculty counsellors.

PART V - PROGRAM IMPLEMENTATION

A. Pilot run the program with typical students and instructors.
B. Periodic evaluation of the program by instructors at scheduled intervals during initial implementation.

PART VI - MEASURE AND APPRAISE RESULTS

A. Measures of success.
1. Compare attrition rates with earlier classes.
2. Compare other results to measure success or failure of the program, e.g., pre- and post-test results.

B. Appraisal
   1. Hardware adequacy.
   2. Software program performance and problems.
   3. Program documentation adequacy.

C. Overall subjective appraisal of the success of the course from students and instructors.

PART VII - EXAMINE THE RESULTS TO IDENTIFY POSSIBLE NEW EDUCATIONAL ACTIVITIES

Utilize the student and faculty comments and recommendations to identify additional educational activities where integrating microcomputers would be beneficial.

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